United States Department of Agriculture **Forest Service** **Southwestern Region Forest Health Arizona Zone Office**

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Route To:

Subject: Bark Beetle Activity in Recreation Sites on the Prescott NF

To: Ernest Del Rio, District Ranger, Bradshaw RD, Prescott NF

I was requested by your office to assess bark beetle activity in developed recreation sites on the Prescott NF. On September 24, 2002, I traveled to the Prescott to evaluate recreation sites across the Forest and discuss possible prevention and suppression alternatives with District staff (Gary Wittman, Ian Fox, and Malcolm Hamilton). I describe in this report what bark beetle activity was observed in these areas, summarize prevention and control alternatives, and make recommendations to minimize bark beetle impacts.

Bark beetle activity on the Prescott NF

Both aerial detection surveys and ground surveys conducted by FHP have found high levels of bark beetle-killed ponderosa pine on the Prescott NF (***Figures 1, 2***). Inspection of fading trees and collected specimens determined that the Arizona 5-spined ips (*Ips lecontei*) is the primary cause of pine mortality. This bark beetle is found throughout the Southwest and into Central America, although the most significant economic damage is limited to central and southern Arizona (Massey and Parker, 1981). Most of the attacked trees show the characteristic fading from the top down. Many of the larger-diameter pine with top kill also have western pine beetle (*Dendroctonus brevicomis*) or roundheaded pine beetle (*D. adjunctus*) beginning to attack the lower portion of the trunks.

Figure 1. *Ips-killed ponderosa pine in the Prescott Basin.*

A detailed summary of the aerial detection survey results will be provided to the Forest at a later date; however, our preliminary analysis showed that nearly 75,000 acres have Ips-caused mortality of ponderosa pine, totaling almost ½ million trees killed. This pine mortality is not unique to the Bradshaw RD. High levels of both ponderosa and pinyon pine mortality have been documented across the state and throughout the Southwest

during 2002. Within many of these areas, ponderosa pine mortality is already greater than 25% for a given stand and as high as 90% in others. The vast majority of this pine mortality is related to the ongoing drought that the Southwest Region has been experiencing since 1996. If beetle populations continue to increase at the rate they have over the past few years, we can expect to see even greater levels of mortality throughout much of the forest.

Bark beetle activity in developed recreation sites

Trees growing in developed recreation sites are often stressed due to repeated damage caused by campers and soil compaction caused by roads and large vehicles parked off-road. During periods of drought or below-average precipitation, such as has been occurring over the last few years, these trees can become extremely stressed. This is further exacerbated by the relatively high density of ponderosa pine growing in some of the campgrounds. When trees are growing at high densities, there is more inter-tree competition for limited resources, such as light, water, and nutrients (Kolb et al., 1998). The combined effect of these factors is lower production of defensive compounds by the trees and, consequently, increased susceptibility to bark beetle attack. Bark beetles may also prefer these dense stands, as compared to more open stands, due to microclimate differences (Amman and Logan, 1998).

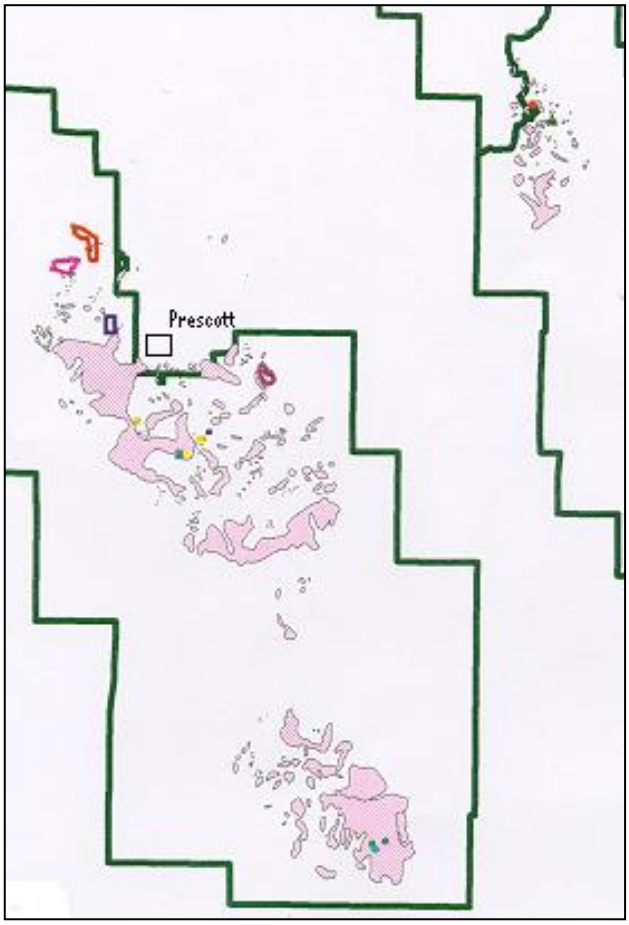

Figure 2. *Location of recreation sites in relation to Ips-caused mortality of pine (red-hatched polygons). Map prepared by Ian Fox.*

Gary, Ian, Malcolm, and I surveyed several of the developed recreation sites for bark beetle activity. Specifically, we examined White Spar CG, Indian Creek CG, Lower and Upper Wolf Creek CG's, Groom Creek Schoolhouse, Potato Patch CG, and Mingus Mountain CG. High levels of bark beetle activity were observed adjacent to or within all of these recreation sites (***Figures 2, 3***). At White Spar and Lower Wolf Creek Campgrounds, we measured the diameters of candidate trees for spraying (***Table 1***). Stand conditions and bark beetle activity in developed recreation sites within the Horsethief Basin Recreation Area were reported earlier (McMillin, 2002). This area is experiencing extreme bark beetle-caused mortality of ponderosa pine.

Table 1. Average diameter at breast height (DBH) of candidate trees to be sprayed in recreation sites on the Prescott National Forest.

Campground	Site	Average DBH
White Spar CG	1	15.1
	2	16.9
Lower Wolf Creek CG	1	15.0
	2	14.8

Prevention and control alternatives for bark beetles

Management of bark beetle populations falls under two categories: direct action against the beetles themselves (control) or indirect action that addresses the general stand conditions (prevention). Direct action deals with the symptoms, too many beetles in one place at one time, and is aimed at directly reducing the number of beetles present. Indirect action focuses on the cause of the problem, which relates to optimal stand conditions for beetle buildup and outbreak. The only effective long-term strategy to minimize beetle-caused mortality is controlling stand conditions through silvicultural means over large areas and constant monitoring for areas of beetle population increases. The following are management alternatives available for consideration:

Figure 3. *Stand conditions and Ips activity at Lower Wolf Creek CG.*

No action. Accept bark beetle-caused tree mortality and the impacts associated with it. The extent of the damage to the stands in this area and surrounding areas is difficult to estimate, but there will be changes in the forest caused by beetles. If stand and weather conditions remain optimal for beetle outbreaks, the impacts can be expected to increase over the next several years.

Where to use: Use where other alternatives are not desired, cannot be used, or are not feasible.

Advantages: There is no mechanical site disturbance. There will be an increase in the amount of light getting to the forest floor, so that understory species and regeneration may be enhanced. Habitat for some wildlife species may be enhanced by decreasing crown closure and creation of standing dead trees.

Disadvantages: This alternative allows beetle populations to increase and spread to other trees and surrounding areas. Fire hazards can also increase with greater levels of dead material, including dry needles. Visual and recreation values can be negatively affected. The loss of

overstory tree cover can have a negative effect for some wildlife species. Regeneration can be impeded as dead trees fall and cover or shade the forest floor. Watershed impacts are possible on steeper slopes due to the decrease in tree canopy interception and root activity.

Silvicultural treatments. These are forest management actions that increase tree vigor and reduce stand susceptibility to beetle attack through reducing basal area or controlling other stand conditions. They are preventive treatments that should be completed prior to stands experiencing beetle outbreaks. No stand hazard rating models have been developed for pine engraver beetles species attacking ponderosa pine, primarily because beetle populations are driven by drought and factors leading to large amounts of slash. Stand hazard rating for *Dendroctonus* bark beetles of ponderosa pine involves measures of tree size, stand or group density (basal area), and the percent of host trees within the stand. In general, ponderosa pine stands that have an average DBH greater than 12 inches and a basal area greater than 120 ft^2/acre are considered to be at high risk to bark beetle attack (Chojnacky, et al., 2000; Negrón, et al., 2000). In the Prescott Basin, stands that have less than 80 square feet of basal area per acre should be considered the lowest risk. It is important to keep in mind that while thinning your trees is an excellent long-term preventive measure, thinning alone may not be enough to protect trees from bark beetles. In order for the leave trees to benefit from thinning, they need water before beetles start an attack. All the fresh cut "slash" (cut tree trunks, limbs and trimming debris) must be treated properly to keep beetles from breeding in it and moving into adjacent residual green trees.

> Where to use: This is a preventive strategy and should be used regularly when planning tree removal, urban interface treatments, and maintaining recreation sites. Thinning or other silvicultural treatments should not be considered a stand-alone tool in areas currently experiencing a beetle outbreak.

Advantages: Controlling stand conditions can reduce overall stand susceptibility to beetle infestation. It does not guarantee that beetle-caused mortality will be eliminated; it creates conditions that are less likely to experience a beetle outbreak. It can maximize the economic return from tree removal, as cutting is done prior to mortality taking place. Although the forest will experience mortality through time, treating stands through silvicultural prescriptions allows the decisions on what the forest will look like in the future through the types of treatments implemented. If not, the beetles will decide what the forest will look like in the future through their actions, and this may be considerably different from management goals, or not within limits of change acceptable to the public.

Disadvantages: This action is not suitable for areas where tree removal or treatment of slash is not feasible. There is the site disturbances associated with treatments or tree removal while the cutting is being done.

Sanitation/salvage removal. Sanitation removal involves removing currently infested pines prior to the beetle maturation and emergence. It requires the removal of green trees that have live brood in them. Trees removed are treated; either moved to at least one mile from the nearest live host type or processed at the mill, prior to beetle emergence. Salvage removal involves the taking away of beetle-killed trees that do not have live beetles in them. These trees have already changed color; all their needles are either red or gone.

Where to use: In stands susceptible to bark beetles that are currently under attack and where it is desirable to reduce beetle populations and recover resource value. Also appropriate where beetle populations threaten currently uninfested nearby stands, adjacent private lands, and recreation sites.

Advantages: Bark beetle populations can be reduced in localized areas and in individual stands by removing most of the currently infested trees. This can provide some protection to surrounding uninfested trees and stands by removing a large source of attacking beetles. Resource values are recovered that would otherwise be lost or degraded. Fuel loading and fire hazard can be reduced by removal of much of the dead needles and timber. Regeneration can be enhanced through overstory removal and site disturbance. Potential hazard trees are also removed from the site.

Disadvantages: This alternative has a short implementation time. Areas must be marked and cut prior to beetle flight; i.e., before the beginning of April or within four weeks of the initial attack. Sanitation removal is only effective at suppressing beetles at the stand level and is not typically effective on a landscape scale. Site disturbance that accompanies tree removal occurs.

Infested tree treatment. Cut and individually treat infested trees prior to beetle emergence. The action should kill most or all of the beetles within the cut trees. Examples of treatments include: cut and burn on site, cut and bury at least six inches deep on site, cut and chip, or cut and debark. When burning infested trees or slash, the material does not need to be entirely consumed; only the outer bark and cambium needs to be charred significantly enough to kill the brood. The use of a terra torch has been proven effective at treating infested green slash piles in Arizona.

Where to use: This is most appropriate for treating small spots in areas where high value resources are nearby.

Advantages: Small spot beetle populations can be reduced or eliminated from the treated area. This can provide some relief to surrounding uninfested stands and trees. The site disturbance is less than in conventional tree removal operations. Regeneration can be enhanced through the removal of overstory trees. Fire hazard and hazard trees can be reduced.

Disadvantages: The implementation time for this alternative is short. Treatments must be done after new infested trees are located and prior to beetle flight. This treatment only reduces beetle pressure in a small area; it is not effective on a landscape scale. This treatment does not address stand conditions that led to beetle buildup in the first place.

Protection of high-value trees. Valuable trees in recreation sites or near homes may be sprayed with carbaryl (Sevin products) to prevent successful attack (Parker, 1991). Both the trunk and large branches (>4” diameter) should be sprayed. Because pine engraver beetles generally initiate attacks near the top of the bole, it is important that the spray reach this area. Attacking beetles die as they attempt to chew through the bark. Preventive sprays are not recommended for trees already attacked. Large-diameter green slash can potentially be protected using preventive

sprays. Systemic injections of insecticides do not work either as a preventive or a direct control of bark beetles on pine (Haverty, et al., 1996).

> Where to use: On trees around residences, in campgrounds, or other high value areas. Trees must be of significantly high value and be under heavy beetle pressure to justify treatment costs.

Advantages: This action can be effective at protecting individual trees from becoming infested if applied properly.

Disadvantages: Insecticide application does not effectively reduce beetle populations or address the cause of the outbreak. It does not guarantee protection; application must be thorough for it to be effective. Many people have concerns regarding environmental contamination when using pesticides. It is extremely expensive on a large scale and, therefore, is only appropriate for high-value trees within a small area, such as in campgrounds and other administrative sites. Analysis of environmental effects is more involved before use on Federal lands is permitted, and application by a licensed pesticide applicator is required.

Recommendations

Because the current beetle infestation is occurring on the landscape scale and is largely a result of the ongoing drought, it is essentially impossible to control the beetle population as a whole through management actions. Therefore, control actions should probably be limited to the most critical, high-value areas that have adequate accessibility.

Based on the current weather and stand conditions, setting, and large population of bark beetles within the immediate area, trees within all of the campgrounds are highly susceptible to beetle attack. Therefore, a combination of removal of infested trees, application of preventive insecticide sprays, and thinning is recommended.

It is recommended that the infested trees be removed yet this winter before the brood completes development and adult beetles emerge. If trees are cut, they must either be removed from the site, or if left, the bark should be stripped off to kill the developing beetle brood.

While visiting the recreation sites, we discussed strategies for applying the preventive sprays. Malcolm suggested that five to ten trees per campsite or picnic area are needed to provide adequate shade and screening. Therefore, we decided to use this as a general guide for determining the number of trees to be sprayed within a campground or day-use area. Candidate trees include those that have good structural form, are 12 inches and larger, and are close to tent pads, cooking areas and picnic tables. Further spraying guidelines will be provided to the Forest at a later date.

Ian and Gary have developed a thinning prescription for removing the smaller-diameter trees that are competing with larger trees for site resources. When carrying out this prescription, careful management of the slash is required while populations are high. Removal of thinning slash from

the recreation areas is the best option. If treated on site, burning, chipping, or burying green slash will help to reduce the potential for additional population increase of beetles.

Although no experimental studies have been conducted to examine the relationship between chipping and bark beetle attraction, we do know that bark beetles are attracted to host tree compounds such as terpenes. Fresh cut trees and chips release high quantities of terpene volatiles that can attract bark beetles. To minimize the potential of chips attracting bark beetles, chips should be spread out as much as possible in open areas rather than in shaded areas, or removed from the site. Try to prevent piling the chips at the bases of pine trees. If the chips are spread out in a thin layer and out in the sun, they will dry quickly and, therefore, stop emitting terpene volatiles. Chipping in the fall probably has less risk than chipping at other times of the year.

Funds may be available for FY2003 from Forest Health Protection to deal with bark beetle activity within the Prescott area. Requests to use these funds should be in no later than October 18, 2002. If you have any questions regarding my assessment of current bark beetle activities within the project area, its potential effect on residual standing trees, or my recommendations, please let me know. I can be reached at (928) 556-2074.

/s/ Joel D. Mcmillin
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Entomologist, Forest Health, Arizona Zone

cc: Ian R Fox, Gary C Wittman, John Anhold, Leonard Lucero, Debra Allen-Reid, Douglas L Parker, Malcolm H Hamilton

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